AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

CLAIMS

Claims1-2. (canceled)

Claim 3 (currently amended) ~~The~~ A multi-tone modem ~~of Claim 1, wherein the message processor further comprises:~~ with a plurality of components forming a transmit path and a receive path; and the receive path components of the multi-tone modem comprising:

a fast Fourier transform (FFT) component to convert multiple received tones in a time domain to successive symbols in a frequency domain, with each of the successive symbols including pilot sub-symbols together with message sub-symbols;

a message processor coupled to the FFT and the message processor operable to select pairs of message and pilot sub-symbols in each symbol and to equalize the message sub-symbol with the pilot sub-symbol in each pair of sub-symbols to substantially remove from the message sub-symbol frequency dependent phase shifts between the tones of each symbol; and the message processor including:

- a pseudo-equalizer for multiplying the message sub-symbol times the complex conjugate of the pilot sub-symbol in each pair of message and pilot sub-symbols to substantially remove from the message sub-symbol the frequency dependent phase shifts therein~~.~~ and;

a decoder coupled to the message processor for decoding each message sub-symbol equalized in the act of equalizing to the corresponding message data.

Claims 4-5 (canceled)

Claim 6 (currently amended) ~~The~~ A multi-tone modem ~~of Claim 1, wherein the message processor further comprises:~~ with a plurality of components forming a transmit path and a receive path; and the receive path components of the multi-tone modem comprising:

a fast Fourier transform (FFT) component to convert multiple received tones in a time domain to successive symbols in a frequency domain, with each of the successive symbols including pilot sub-symbols together with message sub-symbols;

a message processor coupled to the FFT and the message processor operable to select pairs of message and pilot sub-symbols in each symbol and to equalize the message sub-symbol with the pilot sub-symbol in each pair of sub-symbols to substantially remove from the message sub-symbol frequency dependent phase shifts between the tones of each symbol; and the message processor including:

- a de-scrambler for asymmetrically de-scrambling the message sub-symbols and the pilot sub-symbols with the asymmetrical de-scrambling resulting in each message sub-symbol and pilot sub-symbol exhibiting a fixed phase bias; and

a decoder coupled to the message processor for decoding each message sub-symbol equalized in the act of equalizing to the corresponding message data, wherein the decoder further decodes each message symbol with a decoding table which removes the fixed phase bias imparted by the de-scrambler.

Claim 7 (currently amended) ~~The~~ A multi-tone modem ~~of Claim 1, wherein the message processor further comprises:~~ with a plurality of components forming a transmit path and a receive path; and the receive path components of the multi-tone modem comprising:

a fast Fourier transform (FFT) component to convert multiple received tones in a time domain to successive symbols in a frequency domain, with each of the successive symbols including pilot sub-symbols together with message sub-symbols;

a message processor coupled to the FFT and the message processor operable to select pairs of message and pilot sub-symbols in each symbol and to equalize the message sub-symbol with the pilot sub-symbol in each pair of sub-symbols to substantially remove from the message sub-symbol frequency dependent phase shifts between the tones of each symbol; and the message processor including:

- a diversity combiner for combining selected ones of the equalized message sub-symbols redundant with respect to one another in terms of the message data encoded therein to produce at least one unique message sub-symbol with a reduced noise level therein; and

a decoder coupled to the message processor for decoding each message sub-symbol equalized in the act of equalizing to the corresponding message data, wherein the decoder further decodes the at least one unique message sub-symbol to the corresponding message data.

Claims 8-9 (canceled)

Claim 10 (currently amended) ~~The~~ A method ~~of Claim 8, wherein the equalizing act further comprises the act of:~~ for demodulating data received over a communication medium with a communication channel with multiple pilot tones with pilot data modulated thereon and message tones with message data modulated thereon; and the method for demodulating comprising:

converting the received data from a time domain to a frequency domain with the received data in the frequency domain including successive symbols each including pilot sub-symbols together with message sub-symbols;

selecting pairs of message and pilot sub-symbols in each symbol;

equalizing the message sub-symbol with the pilot sub-symbol in each pair of sub-symbols to substantially remove from the message sub-symbol frequency dependent phase shifts imparted to the communication channel, including multiplying the message sub-symbol times the complex conjugate of the pilot sub-symbol in each pair selected in the act of

selecting to substantially remove from the message sub-symbol the frequency dependent phase shifts therein~~.~~; and

decoding each message sub-symbol equalized in the act of equalizing to the corresponding message data.

Claims 11-12 (canceled)

Claim 13 (currently amended) ~~The~~ A method ~~of Claim 8, wherein the act prior to the selecting act further comprises:~~ for demodulating data received over a communication medium with a communication channel with multiple pilot tones with pilot data modulated thereon and message tones with message data modulated thereon; and the method for demodulating comprising:

converting the received data from a time domain to a frequency domain with the received data in the frequency domain including successive symbols each including pilot sub-symbols together with message sub-symbols;

asymmetrically de-scrambling the message sub-symbols and the pilot sub-symbols with the asymmetrical de-scrambling resulting in each message sub-symbol and pilot sub-symbol exhibiting a fixed phase bias; ~~and~~

selecting pairs of message and pilot sub-symbols in each symbol;

equalizing the message sub-symbol with the pilot sub-symbol in each pair of sub-symbols to substantially remove from the message sub-symbol frequency dependent phase shifts imparted to the communication channel, including multiplying the message sub-symbol times the complex conjugate of the pilot sub-symbol in each pair selected in the act of selecting to substantially remove from the message sub-symbol the frequency dependent phase shifts therein~~.~~; and

decoding each message sub-symbol equalized in the act of equalizing to the corresponding message data including ~~wherein further the decoding act further comprises~~

decoding each message symbol with a decoding table which removes the fixed phase bias imparted in the asymmetrical de-scrambling act.

Claim 14 (currently amended) ~~The~~ A method ~~of Claim 8, further comprising the act prior to decoding act of:~~ for demodulating data received over a communication medium with a communication channel with multiple pilot tones with pilot data modulated thereon and message tones with message data modulated thereon; and the method for demodulating comprising:

converting the received data from a time domain to a frequency domain with the received data in the frequency domain including successive symbols each including pilot sub-symbols together with message sub-symbols;

selecting pairs of message and pilot sub-symbols in each symbol;

equalizing the message sub-symbol with the pilot sub-symbol in each pair of sub-symbols to substantially remove from the message sub-symbol frequency dependent phase shifts imparted to the communication channel;

combining selected ones of the message sub-symbols equalized in the act of equalizing, with the selected ones of the message sub-symbols redundant with respect to one another in terms of the message data encoded therein to produce at least one unique message sub-symbol with a reduced noise level therein; and

decoding each message sub-symbol equalized in the act of equalizing to the corresponding message data including ~~with the decoding act~~ decoding the at least one unique message sub-symbol to the corresponding message data.

Claims 15-18 (canceled)

Claim 19 (currently amended) ~~The~~ A method of modem training ~~of Claim 17, wherein the equalizing act further comprises the act of:~~ between at least two modems comprising the steps performed at a receiving one of the at least two modems of:

converting a training set of pilot tones and message tones from a time domain to a frequency domain with the received data in the frequency domain including successive training symbols each including pilot sub-symbols together with message sub-symbols;

selecting pairs of message and pilot sub-symbols in each training symbol;

equalizing the message sub-symbol with the pilot sub-symbol in each pair of sub-symbols to substantially remove from the message sub-symbol frequency dependent phase shifts between the tones of each training set including multiplying the message sub-symbol times the complex conjugate of the pilot sub-symbol in each pair selected in the act of selecting to substantially remove from the message sub-symbol the frequency dependent phase shifts therein~~.~~ and;

decoding each message sub-symbol equalized in the act of equalizing to the corresponding message data.

Claims 20-21 (canceled)

Claim 22 (currently amended) ~~The~~ A method of modem training ~~of Claim 17, wherein the act prior to the selecting act further comprises:~~ between at least two modems comprising the steps performed at a receiving one of the at least two modems of:

converting a training set of pilot tones and message tones from a time domain to a frequency domain with the received data in the frequency domain including successive training symbols each including pilot sub-symbols together with message sub-symbols;

asymmetrically de-scrambling the message sub-symbols and the pilot sub-symbols with the asymmetrical de-scrambling resulting in each message sub-symbol and pilot sub-symbol exhibiting a fixed phase bias; ~~and~~

selecting pairs of message and pilot sub-symbols in each training symbol;

equalizing the message sub-symbol with the pilot sub-symbol in each pair of sub-symbols to substantially remove from the message sub-symbol frequency dependent phase shifts between the tones of each training set; and

decoding each message sub-symbol equalized in the act of equalizing to the corresponding message data including ~~wherein further the decoding act further comprises~~ decoding each message symbol with a decoding table which removes the fixed phase bias imparted in the asymmetrical de-scrambling act.

Claim 23 (currently amended) ~~The~~ A method of modem training ~~of Claim 17, further comprising the act prior to decoding act of:~~ between at least two modems comprising the steps performed at a receiving one of the at least two modems of:

converting a training set of pilot tones and message tones from a time domain to a frequency domain with the received data in the frequency domain including successive training symbols each including pilot sub-symbols together with message sub-symbols;

selecting pairs of message and pilot sub-symbols in each training symbol;
equalizing the message sub-symbol with the pilot sub-symbol in each pair of sub-symbols to substantially remove from the message sub-symbol frequency dependent phase shifts between the tones of each training set;

combining selected ones of the message sub-symbols equalized in the act of equalizing, with the selected ones of the message sub-symbols redundant with respect to one another in terms of the message data encoded therein to produce at least one unique message sub-symbol with a reduced noise level therein; and

decoding each message sub-symbol equalized in the act of equalizing to the corresponding message data including ~~with the decoding act~~ decoding the at least one unique message sub-symbol to the corresponding message data.